

AD-A058 206

ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT COMM--ETC F/G 13/6
TRACTOR, WHEELED, WAREHOUSE, GASOLINE, 4000-POUND-DRAWBAR-PULL,--ETC(U)
MAR 78 J E STEPHENS, J W REID

UNCLASSIFIED

MERADCOM-2238

NL

| OF |

AD
A058206



END
DATE
FILMED
10-78
DDC



AD NU. _____

AD A 058206

DDC FILE COPY



②

TRACTOR, WHEELED, WAREHOUSE, GASOLINE,
4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRE
USER SURVEY

⑩

by
James E. Stephens, Jr.
and
Jesse W. Reid, Jr.

⑪

March 1978

⑫

52p.

AD

⑭

MERADCOM-

Report 2238

LEVEL

DDC
RECEIVED
AUG 31 1978
A

Approved for public release; distribution unlimited.

U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA

403 160
78 08 30 026

Destroy this report when it is no longer needed. Do not return it to the originator.

The citation in this report of trade names of commercially available products does not constitute official endorsement or approval of the use of such products.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER 2238	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) TRACTOR, WHEELED, WAREHOUSE, GASOLINE, 4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRE - USER SURVEY		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s) James E. Stephens, Jr. Jesse W. Reid, Jr.		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS Mechanical and Construction Equipment Lab, DRDME-HM U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, Virginia 22060		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS Commander U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, Virginia 22060		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE March 1978
		13. NUMBER OF PAGES 53
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Material-Handling Equipment Reliability, Availability, and Maintainability Warehouse Tractor Quality Assurance Gasoline Engine Specification Pneumatic Tire Procurement Maintenance		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report is the result of emphasis on procuring commercial items in lieu of Military Adaptation of Commercial Items (MACI). Four major manufacturers of commercial warehouse tractors were surveyed to determine their candidate models for Army and commercial use. This report presents the methodology, results, and conclusions of evaluating the established commercial market acceptability of these tractors. Commercial users of the tractors were visited by a Survey Team using a User Survey Questionnaire designed to obtain the data required. The results are discussed (Continued)		

DD FORM 1 JAN 73 1473

EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)



UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

(Block 20 Cont'd)

and commercial warehouse tractors are compared for variance with the requirements of the existing MACI specification for warehouse tractors.

The Survey results support this general conclusion: The Reliability, Availability, and Maintainability (RAM) characteristics of the commercial warehouse tractors surveyed are acceptable to their commercial users.

ACCESSION No.	
NTIS	White Section <input checked="" type="checkbox"/>
DDC	Soft Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION.....	
.....	
BY.....	
DISTRIBUTION/AVAILABILITY CODES	
Dist.	AVAIL. exp. or SPECIAL
	

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

CONTENTS

Section	Title	Page
	ILLUSTRATIONS	iv
	TABLES	iv
	METRIC CONVERSION FACTORS	v
I	INTRODUCTION	
	1. Background	1
	2. Description of Materiel	1
	3. Objective	6
	4. Scope	6
II	USER SURVEY	
	5. Preparation of the User Survey Questionnaire	8
	6. Selection of Users to be Surveyed	8
III	RESULTS OF USER SURVEY	
	7. <i>Life-Cycle Management</i>	8
IV	CONCLUSIONS	
	8. Conclusions	12
	APPENDIX A – Questionnaire for User Evaluation of Commercial TOW Tractors	13
	APPENDIX B – Results from Survey of Eight Industrial Users of 4000-Pound-Drawbar-Pull Warehouse Tractors	28

ILLUSTRATIONS

Figure	Title	Page
1	Clark CT-40 Warehouse Tractor	2
2	Northwestern J6-40PT15 Warehouse Tractor	3
3	Pettibone Huskie Model 40 Warehouse Tractor	4
4	United Shop Mule SM-40 Warehouse Tractor	5
5	Warehouse Tractor Purchased by Contract Using Military Standard MIL-T-52852	7

TABLES

Table	Title	Page
1	Warehouse Tractors Listed by Four Manufacturers Surveyed	1
2	Users Surveyed	8
3	User Response to RAM-Related Questions	10
4	Average Time to Remove and Replace Frequently Replaced Components	11
5	Removal/Replacement Times from User Surveys vs. Requirement from Specification (MIL-T-52852)	11

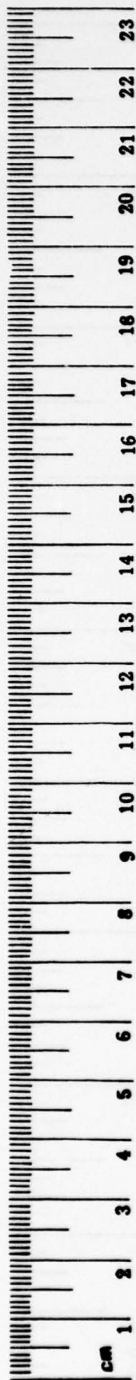
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
in	inches	2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
AREA				
in ²	square inches	6.5	square centimeters	cm ²
ft ²	square feet	0.09	square meters	m ²
yd ²	square yards	0.8	square meters	m ²
mi ²	square miles	2.6	square kilometers	km ²
	acres	0.4	hectares	ha
MASS (weight)				
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric tons	t
VOLUME				
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft ³	cubic feet	0.03	cubic meters	m ³
yd ³	cubic yards	0.76	cubic meters	m ³
TEMPERATURE (exact)				
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

* 1 in = 2.54 cm (exactly).





Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
--------	---------------	-------------	---------	--------

LENGTH

mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi

AREA

cm ²	square centimeters	0.16	square inches	in ²
m ²	square meters	1.2	square yards	yd ²
km ²	square kilometers	0.4	square miles	mi ²
ha	hectares (10 000 m ²)	2.5	acres	

MASS (weight)

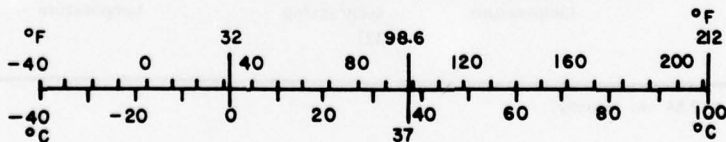
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric tons (1000 kg)	1.1	short tons	

VOLUME

ml	milliliters	0.03	fluid ounces	fl oz
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m ³	cubic meters	35	cubic feet	ft ³
m ³	cubic meters	1.3	cubic yards	yd ³

TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
----	---------------------	-------------------	------------------------	----



**TRACTOR, WHEELED, WAREHOUSE, GASOLINE,
4000-POUND-DRAWBAR-PULL, PNEUMATIC-TIRE – USER SURVEY**

I. INTRODUCTION

1. **Background.** On 24 May 1976, the Office of Management and Budget directed the Government to emphasize the acquisition of commercial, off-the-shelf products in order to achieve optimal effectiveness in supply support operations. The resulting emphasis on procurement of commercial products included the warehouse tractor. A program was undertaken by MERADCOM to develop a procurement document whereby commercial, off-the-shelf warehouse tractors can be procured and supported. The major elements in this program are as follows:

- a. Prepare the Manufacturer Survey Questionnaire.
- b. Conduct and report the Manufacturer Survey.
- c. Prepare the User Survey Questionnaire.
- d. Conduct and report the User Survey.
- e. Develop the procurement specification.
- f. Procure commercial warehouse tractors.
- g. Type classify.

The first two program elements have been completed and are reported separately.

2. **Description of Materiel.** Table 1 summarizes the warehouse tractor each manufacturer described in a Technical Information Package (TIP) submitted to MERADCOM. These tractors are shown in Figures 1 through 4. Each manufacturer

Table 1. Warehouse Tractors Listed by Four Manufacturers Surveyed

Manufacturer	Warehouse Tractor Model
Clark	CT-40
Northwestern	J6-40PT15
Pettibone	Huskie Model 40
United	Shop Mule SM-40

described his warehouse tractor as "commercial" and "off-the-shelf" which would satisfy the Army's requirement for warehouse tractors. This class of warehouse tractor can be identified as follows:



Figure 1. Clark CT-40 warehouse tractor.

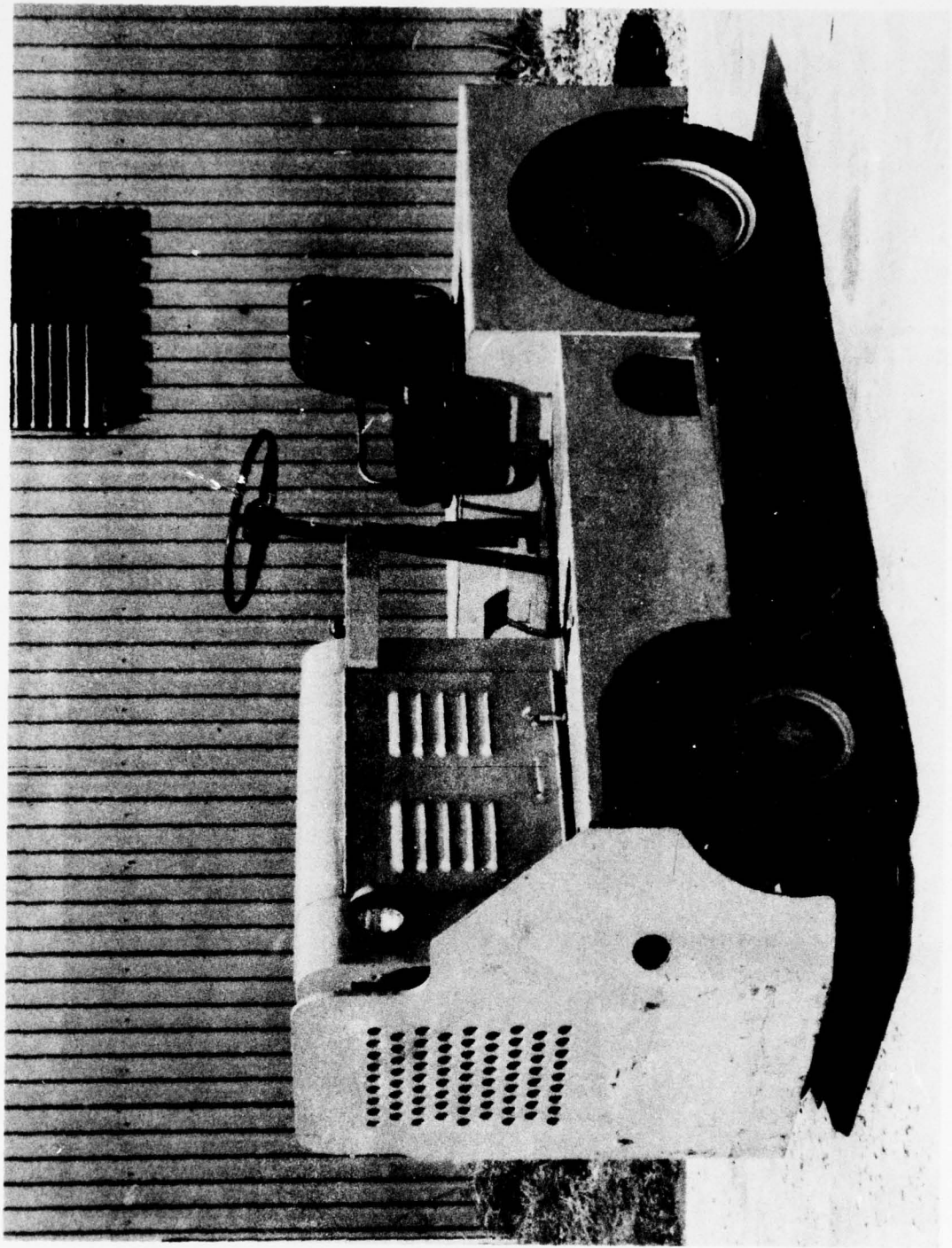


Figure 2. Northwestern J6-40PT15 warehouse tractor.

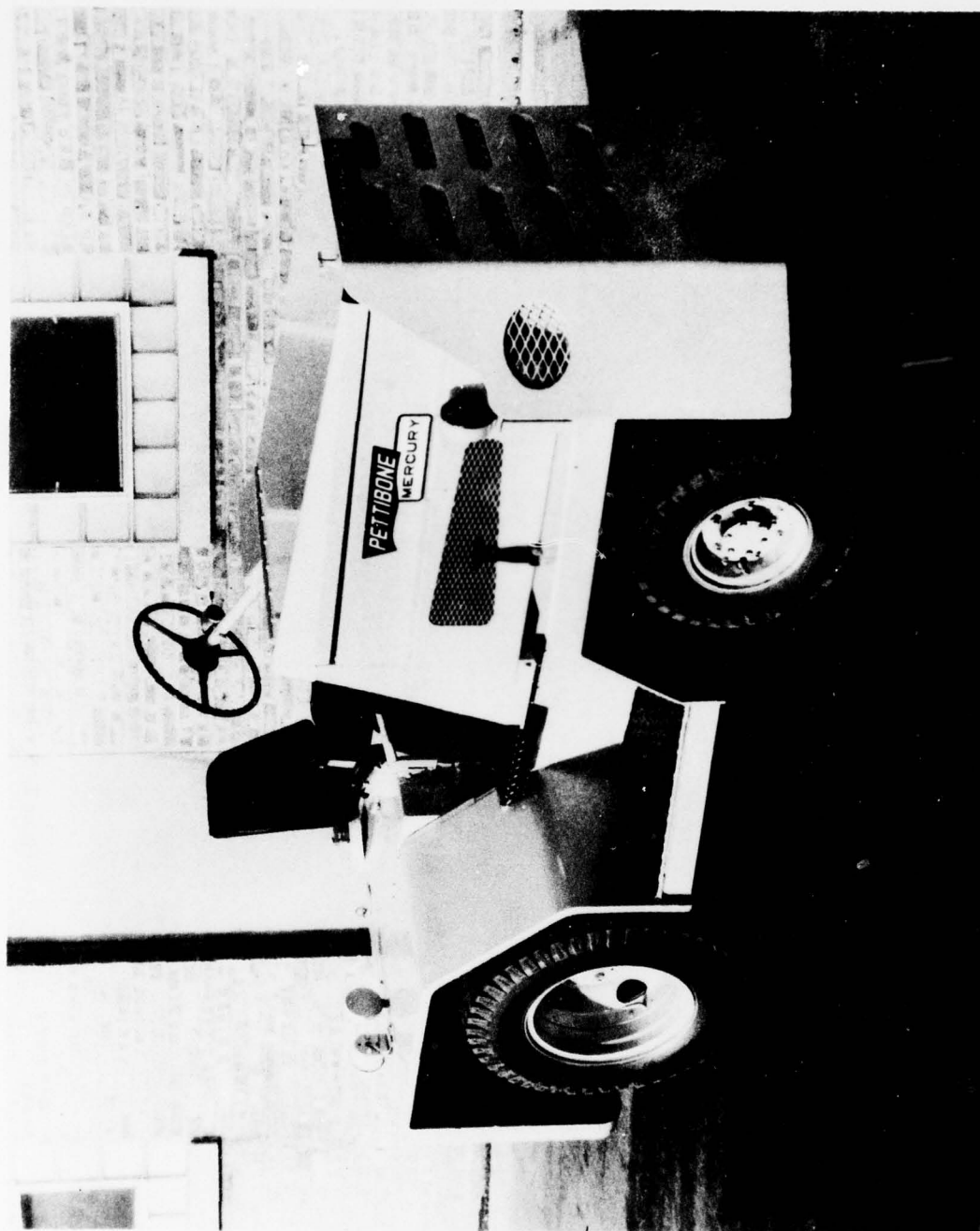


Figure 3. Pettibone Huskie Model 40 warehouse tractor.

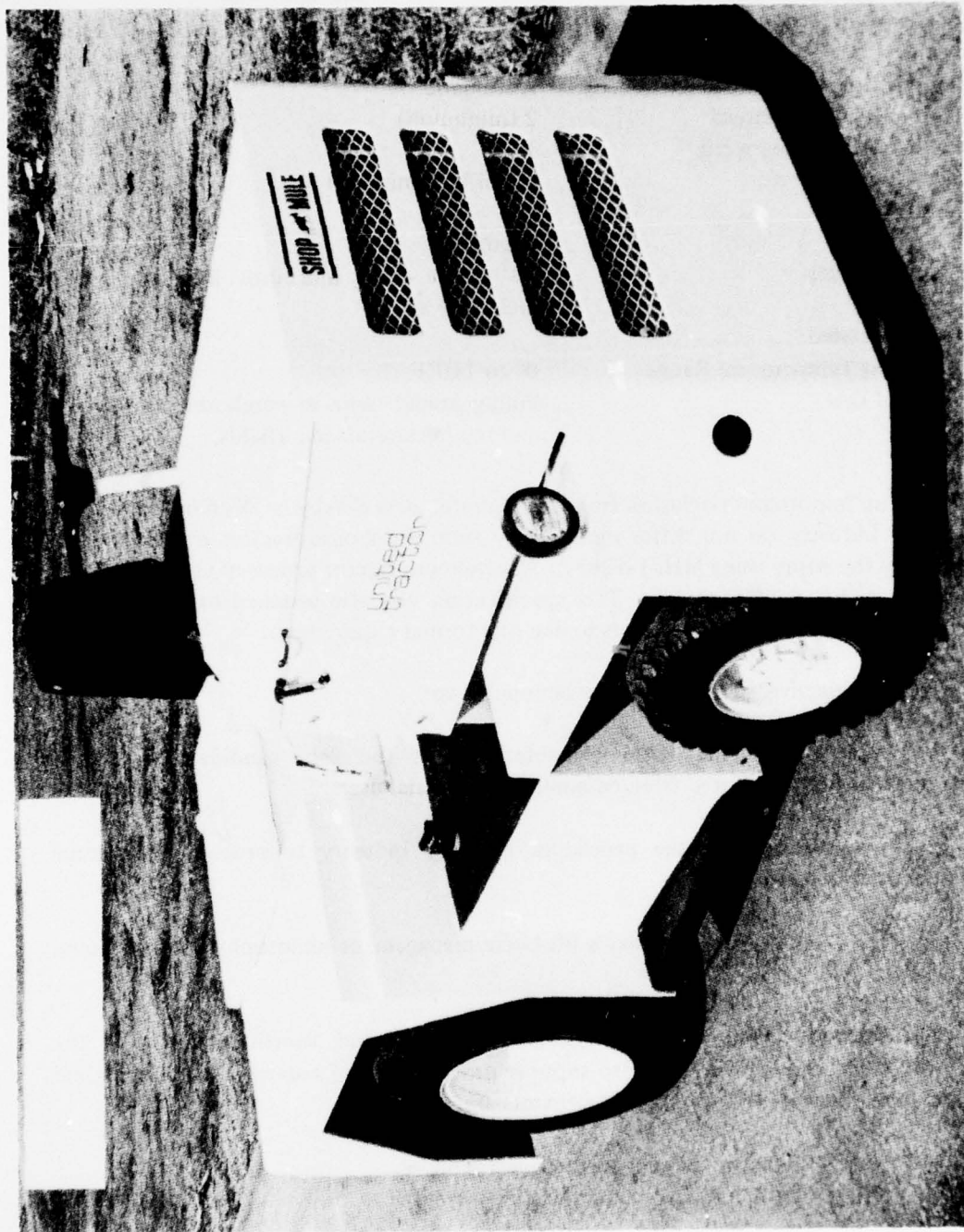


Figure 4. United Shop Mule SM-40 warehouse tractor.

<u>Characteristic</u>	<u>Requirement</u>
Drawbar Pull	4000-lb (minimum)
Engine	Gasoline
Transmission	Automatic
Number Speeds Forward	2 (minimum)
Number Speeds Rearward	1
Speed	12 mi/h (minimum)
Tires: Number	4
Type	Pneumatic
Maneuverability	90° turns from and into intersecting 90-inch-wide aisles
Mission Related:	
Ambient Temperature Range	0° to 110°F
Typical Use	Pulling trailer trains in warehouses and depots and towing aircraft in airfields.

Finally, an important conclusion from the Manufacturer Survey is: Warehouse tractors used by Industry do not differ significantly from warehouse tractors previously procured by the Army using MIL-T-52852. A warehouse tractor procured using this specification is shown in Figure 5. This specification was also assumed to represent the requirement for warehouse tractors in lieu of a formal requirement.

3. Objective: This survey was conducted to:

- a. Assess the RAM characteristics of the four candidate warehouse tractors using data solicited from commercial/industrial users.
- b. Determine the procedure used by Industry to procure commercial warehouse tractors.
- c. Determine Industry's life-cycle management philosophy for warehouse tractors.

4. Scope: This report considers the third and fourth elements of the MERADCOM program designed to support procurement of commercial, off-the-shelf warehouse tractors. These program elements are:

- a. Preparing the user survey questionnaire.
- b. Conducting/reporting the user survey.

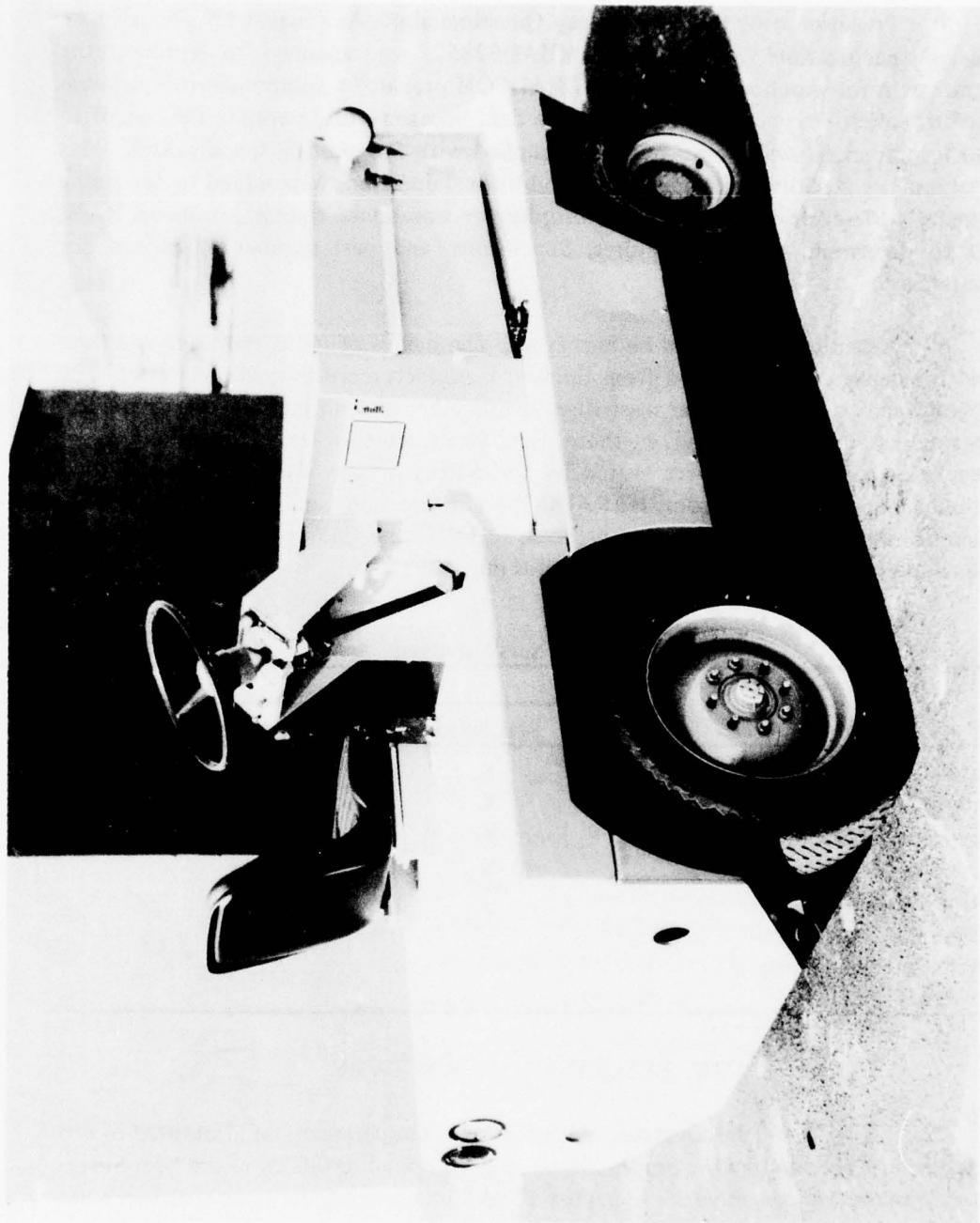


Figure 5. Warehouse tractor purchased by contract using Military Standard MIL-T-52852.

II. USER SURVEY

5. **Preparation of the User Survey Questionnaire:** As discussed previously, the existing specification for this item, MIL-T-52852, was assumed to represent the requirement for warehouse tractors. MERADCOM prepared a comprehensive questionnaire to solicit from commercial users the data necessary to determine the extent to which commercial warehouse tractors complied with the existing specification. This questionnaire is shown in Appendix A. Additional questions were added to determine Industry's life-cycle management philosophy for warehouse tractors, to assess RAM, and to determine the manufacturer, dimensions, and part number of each major component.

6. **Selection of Users to be Surveyed:** The names of industrial users and their servicing dealers were obtained from the four manufacturers surveyed previously. The program goal was to survey at least three major users of each manufacturer's tractor. When necessary, minor users (i.e., those using two tractors or less) were visited. Eight users, shown in Table 2, were visited by the Survey Team. Survey Team members included representatives from MERADCOM (Engineering) and TARCOM (Quality Assurance/Maintenance). The Survey Team recorded the findings of their visit on the User Survey Questionnaire developed for this purpose.

Table 2. Users Surveyed

User	Tractor			
	Clark	Pettibone	Northwestern	United
Ford Motor Co.		X		
Caterpillar Tractor Co.		X		
Reynolds Metal Co.		X		
Reynolds Metal Co.		X		
Kaiser Aluminum				X
Casper Air Service			X	
North Central Airlines			X	
Reynolds Metal Co.	X			

III. RESULTS OF USER SURVEY

7. **Life-Cycle Management.** All users were cooperative and attempted to provide the data solicited by the Survey Team. The compiled results from the User Survey Questionnaire are presented in Appendix B. A discussion of the industrial user's life-cycle management for 4000-lb-drawbar-pull warehouse tractors follows:

a. Industry purchases the warehouse tractor for a specific task and equips it to match the work station environment. As an example, one user has an extremely dusty work station environment and specifies two air cleaners (two-stage followed by an oil bath). Further, Industry generally can assume the warehouse tractor will be assigned to one work station all of its economic life.

b. At purchase time, industrial users are not bound by the lowest purchase price; only one user cited lowest price as the reason for purchasing a specific make and model. Instead, preference for a make and model, quality, and/or lowest operating cost were cited as reasons for purchasing a particular make and model. Obviously, qualifying these factors is difficult, especially within the same corporation; but at separate plants, different make and model warehouse tractors are preferred. From user comments, this preference for a specific make and model can be related to two factors: The dealer and the operator. A strong local dealer able to support the user's vehicle logistically definitely has an advantage when the user rebuys. Finally, the mechanic and operator's preconceived feelings about a certain make and model tractor may cause him to question the acceptability of an alternate make and model. Therefore, if prices are within reason, users tend to buy for reasons other than just lowest initial cost. It is significant to note that the one user who selected the lowest priced tractor is dissatisfied and is the only user who stated he would not rebuy the same make and model.

c. The manufacturer's warranty to industrial users averages 90 days or 500 hours, whichever comes first. However, two users experienced difficulty invoking the warranty because of agreements with their mechanics' union.

d. The industrial users' acceptance procedures are indicative of their reliance on their local dealers. The dealer sets up the tractor and delivers it to the user. The objective of user inspection/acceptance is simply to verify receipt of the make and model and the optional equipment ordered.

e. Industrial users, in general, do not keep the maintenance records required to support an objective RAM assessment. Typically, the user charged a tractor with all its maintenance time, parts, and supplies, but could not discriminate between scheduled and unscheduled maintenance. Although an objective RAM assessment is impossible, a subjective assessment of commercial warehouse tractors will be attempted using the data from the user surveys. Table 3 highlights the users' responses to questions related to the RAM characteristics of the warehouse tractors surveyed. The responses indicate the general acceptability of commercially available 4000-pound DBP tow tractors to their industrial users; seven out of eight users stated they would rebuy the identical make and model.

Table 3. User Response to RAM-Related Questions

Question	Yes (No.)	No (No.)
Would you rebuy an identical make and model tractor?	7	1
Are you dissatisfied with any features of this equipment?	2*	6
Are there any undesirable or unsatisfactory operating characteristics associated with this equipment?	2**	6
Does the tractor perform satisfactorily under the conditions used?	8	0
Are delays caused by part unavailability?	0	8
Can operators and/or maintenance personnel be trained without difficulty?	8	0
Are there unduly difficult or time-consuming maintenance tasks which contribute to unavailability?	0	8
Are all components accessible for maintenance?	8	0
Have any difficulties been encountered using the maintenance literature?	0	8

* One user considers tractor oversized; another user considers tractors with 2 wheel brakes and manual steering inadequate.

** One user considers tractors too noisy and complained of creeping in neutral. Another user complained of tractor being "cold-blooded" and too fast.

f. The maintenance times associated with frequently performed removal and replacement tasks were estimated by the users surveyed and are shown in Table 4. These times were averaged and are compared in Table 5 to the maintenance time allocated in the existing specification (MIL-T-52852). These average times correlate well with the requirements of the existing specification.

g. Three of the eight users surveyed are equipping their tractors to use LPG. Obviously, this is not a large sample, but the use of LPG-fueled MHE is significant. This observation may signal that the Army should consider the purchase of LPG-fueled MHE.

h. Two major users surveyed specify the maximum noise level of industrial trucks is not to exceed 85 dBA when measured at the operator's ear position with trucks running at governed speed while pulling rated capacity loads. Industrial users are not reluctant to prepare specifications to match this requirement, even if it precludes competitive bidding.

Table 4. Average Time to Remove and Replace Frequently Replaced Components

Manufacturer	Removal/Replacement Time (Minutes) by Component					
	Starter	Voltage Regulator	Battery	Fan Belt	Brake Shoes	Alternator
Clark	60	30	15	60	240	90
Northwestern	45	10	10-15	10-15	120	15-30
Pettibone	40	20	15	35	300	35
United	120	20	30	30	120	30

Table 5. Removal/Replacement Times from User Surveys vs. Requirement from Specification (MIL-T-52852)

Component Removed/Replaced	Removal/Replacement Time (Minutes)	
	User Survey	MIL-T-52852
Starter	66	60
Voltage Regulator	20	20
Battery	18	30
Fan Belt	35	30
Alternator	44	45

i. As discussed previously, the industrial user is not committed to the philosophy of purchasing a warehouse tractor merely because it has the lowest initial cost. This stance was supported by reasons such as dealer proximity, good dealer service, good parts availability, and preference for a make and model. All of these reasons relate to the user's ability to support his tractor logistically. Regardless of make and model, most users stated that parts availability was 48 hours or less. However, all users avoided, whenever possible, the use of high-cost OEM parts by purchasing from local parts jobbers. Preference for a make/model permits the industrial user to justify stocking a larger range of spare parts (extra motor, transmission, etc.). This preference for a make and model also eliminates training problems and, consequently, the industrial users were content with the manufacturer's publications.

IV. CONCLUSIONS

8. **Conclusions.** It is concluded that:

- a. The RAM characteristics of the warehouse tractors surveyed are acceptable to their industrial users.
- b. The industrial user buys a particular make and model for reasons other than lowest initial cost.
- c. The industrial user purchases the warehouse tractor for a specific task in a known work station.
- d. The industrial user is not hesitant to prepare a specification to match his requirement even if it precludes competitive pricing.

APPENDIX A

**QUESTIONNAIRE FOR USER EVALUATION OF COMMERCIAL
TOW-TRACTORS 4000-POUND-DRAWBAR-PULL,
GASOLINE-ENGINE-DRIVEN, PNEUMATIC-TIRED COMMERCIAL
MATERIALS HANDLING EQUIPMENT
(CMHE)**

USER:

NAME _____
ADDRESS _____
TELEPHONE _____
CONTACT _____

EVALUATORS:

NAME	ORGANIZATION
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

SECTION I

SPECIFICATIONS, GENERAL

1. Manufacturer: _____
2. Model number: _____
3. Date model(s) purchased: _____
4. How was this model purchased?
 - A. By specification? _____YES _____NO
 - B. Low bid in a competitive bid? _____YES _____NO
 - C. _____NEW; _____USED
5. Reason for purchasing this model?
 - A. Price of model? _____YES _____NO
 - B. Preference for this particular model? _____YES _____NO
 - C. Availability at time of purchase? _____YES _____NO
 - D. Recommendation from dealer or manufacturer? _____YES _____NO
 - E. Dealer service? _____YES _____NO
 - F. Other: _____

6. Does tractor conform to ANSI B56.4(UL558, UL Label)? _____YES _____NO
7. Present geographical area where model is being used: _____
 - A. Average temperature range: _____
 - B. Extreme temperature range: _____
 - C. Any unusual environmental conditions (dust, etc.)? _____
Any special features required? _____
 - D. Does tractor perform satisfactorily under these conditions? _____YES
_____NO. What if any, actions were required to enable satisfactory operation? _____
 - E. Any difficulty in starting tractor in cold weather? _____YES _____NO
 - F. Is tractor stored outdoors in cold weather? _____YES _____NO
8. End Item performance/characteristics:
 - A. Is the tractor generally assigned to the same operator? _____YES _____NO

- B. What is your maximum rolling load? _____pounds.
- C. What is your maximum grade requirement? _____percent.
- D. What percent of use requires the above maximum rolling load? _____percent.
- E. Type coupler? _____ Automatic; _____ Semiautomatic; _____ Manual
(1) Was coupler specified by user? _____YES _____NO
(2) Was coupler accepted as furnished by manufacturer? _____YES
_____NO
(3) What options, if any, were available? _____
- F. What is coupler height? _____Inches.
- G. How is tractor utilized (towing trailers, aircraft, etc.)? _____

- H. Is tractor speed adequate for your operation? _____YES _____NO. If not, explain _____
- I. What instruments are provided on tractor?
_____Hour meter
_____Fuel gage
_____Engine Oil Pressure Gage or Warning Light
_____Engine Coolant Temperature Gauge or Warning Light
_____Ammeter, Voltmeter, or Warning Light
_____Other _____
- J. What lights are furnished on tractor?
_____Two sealed-beam-type headlights
_____One automotive, red, reflector-type, combination stop-tail light
_____Back-up light(s)
_____Other _____
- K. Are bumpers provided? Front _____ Thickness _____
Rear _____ Thickness _____
- L. Does tractor have:
(1) Gasoline engine? _____
(2) Automatic transmission? _____
(3) Two single, non-driving, steerable front wheels? _____
(4) Two single, driving, non-steerable rear wheels? _____

- (5) Pneumatic tires? _____
- (6) Four-wheel sprung suspension? _____
- (7) Four-wheel split brake system? _____
- M. If tractor has four-wheel sprung suspension, was this feature (option) specified when tractor was purchased? _____YES _____NO. Why? _____

- N. If tractor has four-wheel split-brake system, was this feature (option) specified when tractor was purchased? _____YES _____NO. Why? _____

- O. If tractor does not have either M or N above, is either or both desired? _____YES _____NO. Which one? _____ Why? _____

- P. Does tractor have neutral-start protection? _____YES _____NO
- Q. Can starter motor be reenergized after engine has been started? _____YES _____NO.
- R. Battery and battery terminals:
- (1) Is it 12 volts? _____YES _____NO
- (2) Where is battery located? _____
- (3) Is battery in weathertight compartment? _____YES _____NO
- (4) Is battery accessible for checking and cleaning? _____YES _____NO
- (5) Are battery box, hold-downs, etc., protected with an acid-resistant paint or coating? _____YES _____NO
- (6) Are battery posts identified as to positive and negative? _____YES _____No.
- (7) Are battery cable terminals identified as to positive and negative? _____YES _____NO.

SECTION II

ENGINE AND ENGINE ACCESSORIES

1. Engine:
 - A. Manufacturer: _____
 - B. Model Number: _____
2. Does the engine operate satisfactorily on readily available commercial gasoline?
_____YES _____NO.
3. Does the engine have:
 - A. Choke? _____YES _____NO _____Automatic _____Manual.
 - B. Alternator? _____YES _____NO. How many amps? _____
 - C. Alternator regulator? _____YES _____NO.
 - D. Speed-limiting-type governor? _____YES _____NO.
4. Fuel system:
 - A. Does the system have contaminate filters? _____YES _____NO.
 - B. Fuel tank? _____YES _____NO; Capacity _____Gal; Sufficient for one shift's operation. _____YES _____NO.
 - C. Air cleaner? _____YES _____NO Type: _____Dry _____Oil bath
(1) Is restriction indicator provided? _____YES _____NO.
5. Cooling System:
 - A. Capacity _____Qt.
 - B. Is it effective at all temperature ranges? _____YES _____NO
 - C. Guard protecting the radiator? _____YES _____NO
 - D. Replaceable water pump? _____YES _____NO
 - E. Suction-type fan? _____YES _____NO
6. Lubrication System contaminate filter(s) of the full-flow type? _____YES
_____NO
7. Does the tractor have a positive crankcase ventilation system? _____YES
_____NO
8. Are engine and transmission mounted on elastomer shock mounts? _____YES
_____NO.

SECTION III

SPECIFICATION, DRIVE TRAIN

1. Drive Train. Does the drive train contain the following components:
 - A. Torque converter? _____YES _____NO
 - B. Automatic-shift transmission? _____YES _____NO
 - C. Drive shaft with universal joints? _____YES _____NO
2. Automatic Shift Transmission. Does the transmission have:
 - A. At least two speeds forward? _____YES _____NO
 - B. At least one speed rearward? _____YES _____NO
 - C. Capability to shift under full engine torque? _____YES _____NO
 - D. A heat exchanger to stabilize fluid temperature of the torque converter and transmission? _____YES _____NO
 - E. Full-flow filters having replaceable elements? _____YES _____NO
3. Front Axle:
 - A. Manufacturer: _____
 - B. Type of Suspension: _____
4. Rear Axle:
 - A. Manufacturer: _____
 - B. Type of suspension: _____
5. Front Wheels:
 - A. Tire size: _____
 - B. Number of tires: _____
 - C. Load range (ply rating): _____
6. Rear Wheels:
 - A. Tire Size: _____
 - B. Number of tires: _____
 - C. Load range (ply rating): _____

SECTION IV

SPECIFICATIONS, STEERING AND BRAKES

1. Steering System:
 - A. Type: ☐ Manual ☐ Power
 - B. Manufacturer: _____
 - C. Steering wheel diameter: _____ inches
 - D. Number of turns lock to lock: _____
2. Braking System:
 - A. Front Brakes: ☐ NONE ☐ DRUM ☐ DISC.
Rear Brakes: ☐ NONE ☐ DRUM ☐ DISC.
 - (1) Brake adjustment: ☐ Manual ☐ Self-Adjusting
 - (2) Power assisted: ☐ YES ☐ NO
 - (3) Method of Actuation: ☐ Hydraulic ☐ Vacuum ☐ Other
 - B. Master Brake Valve Manufacturer: _____
 - C. Parking Brake:
 - (1) Type: ☐ Friction ☐ Shoe ☐ Shear ☐ Band
 - (2) Type of actuation: ☐ Lever ☐ Foot
 - (3) Equipped with locking device? ☐ YES ☐ NO
 - (4) Location of brake: ☐ Wheels ☐ Drive shaft ☐ Transmission ☐ Other.
 - D. What is operator's opinion of steering system? _____

 - E. What is operator's opinion of braking capabilities? _____

SECTION V

OPERATOR'S COMPARTMENT

1. Directional Control:
 - A. Actuation: _____ Left Hand _____ Right Hand
 - B. Location: _____
 - C. Position Markings? _____YES _____NO
 - D. Type: _____
2. Seat:
 - A. How many seats? _____
 - B. Is seat covered with coated vinyl upholstery? _____YES _____NO
3. Dimensions:
 - A. Vertical distance between lowest point on steering wheel rim to highest point of the unoccupied seat cushion: _____Inches.
 - B. Height of seat above floor board: _____Inches.
 - C. Height of floor board above ground: _____Inches.
 - D. Height of first step above ground: _____Inches.
 - E. Distance between nearest edge of seat and parking brake: _____Inches.
 - F. Distance between inner edge of accelerator and brake pedal: _____Inches.
 - G. Dimensions of brake pedal: _____Inches.
 - H. Location of pintle hook actuator: _____
4. Cab:
 - A. Was tractor bought with cab? _____YES _____NO
 - B. Does tractor now have a cab? _____YES _____NO
 - C. Is a cab desired on tractor? _____YES _____NO
 - D. Is cab equipped with heater/defroster? _____YES _____NO
5. Other options:

Other than a cab, what options were furnished or are on the tractor? _____

SECTION VI

TRACTOR DIMENSIONS, PERFORMANCE, MISCELLANEOUS

1. Overall length: _____Inches.
2. Overall width: _____Inches.
3. Overall height w/o cab: _____Inches; w/cab _____Inches.
4. Wheel base: _____Inches.
5. Drive tire tread width (℄ to ℄): _____Inches.
6. Steer tire tread width (℄ to ℄): _____Inches.
7. Drive tire clearance to body: _____Inches.
8. Minimum ground clearance: _____Inches.
9. Height of exhaust outlet: _____Inches.
10. Thickness of front bumper plate: _____Inches.
11. Thickness of rear bumper plate: _____Inches.
12. Pintle hook height: _____Inches. Vertical adjustment: _____Inches.
13. Gross vehical weight: _____Lb.
14. Vehicle noise levels:
 - A. No-load governed engine speed: _____dB(A).
 - B. At 4000-lb drawbar pull: _____dB(A).
15. What color is end item painted? _____
16. Is non-slip walkway coating furnished? _____YES _____NO
17. Is tractor furnished with identification, instruction, and warning plates?
_____YES _____NO
How are plates attached? _____
18. Is tractor furnished with slinging and/or tiedown provisions? _____YES
_____NO
19. What equipment has been towed/pulled by the tractor? _____

SECTION VII

RELIABILITY, AVAILABILITY, AND MAINTAINABILITY

1. General Data:

- A. Normal workday in clock-hours: _____
- B. Number of shifts per day: _____
- C. Are you dissatisfied with any features of the equipment or your relationship with the manufacturer or dealership? _____YES _____NO (If yes, specify) _____

- D. Are there any undesirable or unsatisfactory operating characteristics associated with the equipment? _____YES _____NO (If yes, specify) _____

- E. Have there been any significant design changes to this model tractor in the last year of which you are aware? _____YES _____NO (If yes, specify) _____

- F. Since purchasing the tractor, have there been any modifications of a corrective or improvement nature made by the:
Manufacturer? _____YES _____NO
Dealer? _____YES _____NO
User? _____YES _____NO
- G. Are there any problems resulting from extreme weather conditions, such as cold-starting difficulties, entrance of rainwater into operating components, etc? _____YES _____NO (If yes, specify) _____

- H. After working shift(s) are completed, where is tractor normally stored?
Outside (no overhead protection; no heat) _____
Outside (overhead protection; no heat) _____
Inside (no heat) _____

Inside (heated bldg) _____

- I. Are tractors replaced on a planned cycle? _____YES _____NO (If yes, specify) _____
- J. Are dealer's repairs effected on a timely basis? _____YES _____NO (If no, explain) _____
- K. Any difficulty in training operators and/or maintenance personnel? _____YES _____NO (If yes, explain) _____
- L. Is timely technical assistance available when required from the:
Dealer? _____; Manufacturer? _____; (Any delays? Explain) _____
- M. Would you repurchase identical make and model tractor? _____YES _____NO (If no, explain) _____
- N. Does the dealer or manufacturer offer any training programs for operators/maintenance personnel? _____Dealer; _____Manufacturer; _____Unknown.
2. Maintainability:
- A. Does manufacturer furnish a copy of his standard warranty upon purchase of tractor? _____YES _____NO
- B. What is the length of warranty on the tractor? _____
- C. What is the total number of warranty claims? _____
- D. Have any parts, items, components, etc. been replaced under warranty since purchase of tractor? _____YES _____NO
- E. What type of maintenance is performed by the:
Operator: _____
Mechanic: _____
- F. Are any components replaced on a scheduled basis? _____YES _____NO
If yes, what components and at what intervals? _____
- G. Are intervals for maintenance functions stated in terms of service hours? _____YES _____NO

- H. Is periodic maintenance accomplished with conventional, general-purpose tools normally associated with this type equipment? ☐ YES ☐ NO
(If no, explain) _____
- I. Are special tools required by operators or mechanics to maintain or trouble-shoot any part of the tractor? ☐ YES ☐ NO (If yes, explain) _____
- J. Do all compartments permit ready access to all items requiring periodic maintenance? ☐ YES ☐ NO
- K. Are there any known maintenance tasks that are unduly difficult or time consuming that contribute to nonavailability? ☐ YES ☐ NO
(If yes, explain) _____
- L. Are delays frequently caused by the lack of timely receipt of repair parts? ☐ YES ☐ NO
- M. What is the length of time to fill emergency orders when parts are not in dealers stock? _____
- N. What is the length of the time to fill normal orders when parts are not in dealers stock? _____
- O. What repair parts do you keep on hand for the tractor? _____

If none are stocked, why not? _____

3. Scheduled Maintenance. Please indicate the interval and average time required for one man using common hand tools and any special tools furnished with the tractor to perform each of the following maintenance operations:
- A. Replace Filters:
- | | | |
|-------------------|----------------|------------|
| (1) Engine Oil: | Interval _____ | Time _____ |
| (2) Air: | Interval _____ | Time _____ |
| (3) Fuel: | Interval _____ | Time _____ |
| (4) Transmission: | Interval _____ | Time _____ |
- B. Drain and Refill:
- | | | |
|-----------------------|----------------|------------|
| (1) Engine Oil: | Interval _____ | Time _____ |
| (2) Transmission Oil: | Interval _____ | Time _____ |
| (3) Cooling System: | Interval _____ | Time _____ |

C. Lubrication: Interval _____ Time _____

D. Preventative Maintenance Time:

(1) Average man-hours expended for daily servicing: _____

(2) Average man-hours expended for weekly preventative maintenance services: _____

(3) Average man-hours expended for monthly preventative maintenance service: _____

4. Component Part Replacement Data. Please indicate the average time required for one man using common tools and special tools furnished with the tractor to perform each of the following maintenance operations. The average time to remove and replace is as follows:

A. Starter: _____

B. Voltage Regulator: _____

C. Battery: _____

D. Fan Belt: _____

E. Brake Shoes: _____

F. Alternator: _____

SECTION VIII

SAFETY/HUMAN FACTORS

1. Are the safety precautions provided by the manufacturer augmented by the user?
_____YES _____NO
2. Do you know of any safety hazards that exist during:
 - A. Operation? _____
 - B. Maintenance? _____
3. Are the following safety and human factors items adequate?
 - A. Controls and gauges: _____YES _____NO
 - B. Controls within easy reach: _____YES _____NO
 - C. Controls clearly marked: _____YES _____NO
 - D. Good operator visibility: _____YES _____NO
 - E. Anti-skid surfaces: _____YES _____NO
 - F. Nonhazardous Step(s): _____YES _____NO
 - G. Does size of operator inhibit his performance? _____YES _____NO
 - H. Does the dress (artic, raincoat, etc) of the operator inhibit his performance?
_____YES _____NO
 - I. Does any known safety hazard exist? _____YES _____NO
 - J. Does tractor operate with any hazardous handling characteristics?
_____YES _____NO
 - K. Does the sound level result in unusual operator fatigue after prolonged operation? _____YES _____NO
 - L. Does the tractor contain special devices that significantly reduce noise levels?
_____YES _____NO (If yes, what) _____

 - M. What is the noise level of tractor in dB? _____
 - N. Are noise level caution (warning) signs posted? _____YES _____NO
 - O. Is any special training required for:
 - (1) Operators? _____YES _____NO
 - (2) Maintenance personnel? _____YES _____NO

SECTION IX

MANUALS

1. Are operator, maintenance, repair, and parts manuals furnished with the tractor?
_____YES _____NO
2. Does manufacturer furnish copy of commercial lubrication and maintenance guide? _____YES _____NO
3. Are technical bulletins provided periodically by the: _____Dealer;
_____Manufacturer; _____Component Manufacturer; _____Not provided.
4. Have difficulties been encountered in using the manuals for service repair, or maintenance instructions? _____YES _____NO. If yes, explain. _____

5. Are the installation and use of options adequately explained in these manuals?
_____YES _____NO. Are separate manuals required? _____YES
_____NO.
6. Is there a system of updating and making revisions to the manuals after issue?
_____YES _____NO. Have any updates or revisions been received since purchase of tractor? _____YES _____NO.

APPENDIX B

RESULTS FROM SURVEY OF EIGHT INDUSTRIAL USERS OF 4000-POUND-DRAWBAR-PULL WAREHOUSE TRACTORS

Manufacturer	Clark	Northwestern				Pettibone				United
1. User number:	N/A	1	2	1	2	3	4			N/A
2. Model number:	CTA-40	JG30PT	JG50PT	40	40	40	A480GT, A-930, A-950			SM50
3. Dates purchased:	74	74-75	75	70-77	75	69	74-77			73-75
4. How purchased:	User Specification (See Note)	See Note		User Specification (See Note)						User Specification (See Note)

NOTE: Clark User — low bid not determining factor. Northwestern User 1 purchased tractor using competitive bidding. Northwestern User 2 — low bid not determining factor. Pettibone User 1 — low bid not determining factor. Pettibone User 2 — low bid not determining factor. Pettibone User 3 — low bid not determining factor. Pettibone User 4 — User Specification. United User — low bid not a determining factor.

5. Why was this make/model purchased?
See Note

See Note See Note See Note

NOTE: Clark User had preference for this make/model. Northwestern User 1 — lowest price. Northwestern User 2 had preference for this make/model. Pettibone User 1 had preference for this make/model because of availability/dealer service/parts availability. Pettibone Users 2, 3, and 4 had preference for this make/model. United User had preference for this make/model because of quality/cost to operate.

6. Does tractor conform to ANSI b56.4 (UL 558, UL Label)?
Yes No

Yes Yes Yes

7. a. How/where is tractor used?
See Note

See Note See Note See Note

	Clark	Northwestern	Pettibone	United
NOTE:	Clark User -- similar to United User and Pettibone Users 1, 2, and 3. Northwestern User 1 and 2 -- at major air terminal, air baggage operation. Tractor is not assigned to one operator; ambient temperature range of -40° F to 90° F. Pettibone User 1 -- in foundry and manufacturing plant exposed to metal chips, oils, sands, and foundry dust. Tractor is not assigned to one operator and is used to tow 120,000-lb rolling loads up to 12 percent grades. Temperature ranges from -27° F to 105° F. Pettibone Users 2 and 3 in an aluminum reduction plant similar to the United User below. Pettibone User 4 -- in automobile manufacturing plants. United User -- in an aluminum reduction plant exposed to abrasive dust and 100° F pot rooms. The tractor is not assigned to one operator and is used to tow 20,000-lb rolling loads on trailers on grades of 2 percent. Tractor has adequate power, as in-plant speed is 7 mi/h.			

- b. What special optional equipment is used for these operating conditions?
- | | | |
|------|----------|----------|
| None | See Note | See Note |
|------|----------|----------|

NOTE: Northwestern User 1 -- heated cabs. Northwestern User 2 -- None. Pettibone User 1 retrofits tractor with self-designed coupler (front and rear), flashing top light, light on coupler, and a dust proofing package. Pettibone User 2 specifies Farr Air Cleaner with pre-cleaners and protectorseal. Pettibone User 3 -- None. Pettibone User 4 -- pre-cleaner. United User specifies LPG or diesel, installs 2-stage Farr Roto Pamic dry-air cleaner followed by an oil-bath air cleaner and a restriction indicator.

- c. Does tractor with this equipment perform satisfactorily?
- | | | |
|-----|----------|-----|
| Yes | See Note | Yes |
|-----|----------|-----|

NOTE: Northwestern User 1 -- dissatisfied with steering which had to be moved to accommodate cab. Northwestern User 2 considers truck too fast.

8. a. What instruments are provided?
- | | | |
|----------|----------|----------|
| See Note | See Note | See Note |
|----------|----------|----------|

NOTE: Clark User -- hour meter, fuel gauge, engine oil pressure indicator, engine coolant temperature indicator, electrical system indicator. Northwestern User 1 -- hour meter, fuel gauge, engine oil pressure gauge, engine coolant temperature gauge, ammeter. Northwestern User 2 hour meter, fuel gauge, engine oil pressure gauge, engine coolant temperature gauge, ammeter. Pettibone User 1 -- hour meter, fuel gauge, engine oil pressure indicator, engine coolant temperature indicator, electrical system indicator. Pettibone User 2 -- Hobb Engine hour meter, fuel gauge, engine oil pressure indicator, engine coolant temperature indicator, electrical system indicator, and torque converter temperature indicator. Pettibone User 3 -- hour meter, fuel gauge, engine oil pressure indicator, engine coolant temperature indicator, electrical system indicator. Pettibone User 4 -- hour meter, fuel gauge, engine oil pressure indicator, engine coolant temperature indicator, electrical system indicator, LPG gas gauge. United User -- hour meter, fuel gauge, engine oil pressure indicator, engine coolant temperature indicator, electrical system indicator, and torque converter oil temperature gauge.

- b. What lights are furnished?
- | | | |
|-------------------|-------------------|-------------------|
| See Note 8a above | See Note 8a above | See Note 8a above |
|-------------------|-------------------|-------------------|

Engine/Engine Accessories		Clark	Northwestern	Pettibone	United
1.	Engine manufacturer:	Ford	Chrysler	Ford	Perkins 4.108 Diesel
2.	Engine model:	240 Ind.	H-225	See Note	Chrysler H225 LPG
NOTE: Pettibone User 1 - Ford 300. Pettibone User 2 - Ford 240. Pettibone User 3 - Chrysler IND-30. Pettibone User 4 - Ford 300 CID.					
3.	Engine accessories:	See Note	See Note	See Note	See Note

NOTE: Clark User - LPG, no choke, alternator (32 amp), alternator regulator, speed limiting governor, positive crankcase ventilation, full flow filters, dry air cleaner. Northwestern User 1 - Automatic choke, alternator (35 amp), alternator regulator, speed-limiting governor, full-flow filters, 14-gallon fuel tank, positive crankcase ventilation, dry-air cleaner. Northwestern User 2 - manual choke, alternator (35 amps), alternator regulator, speed limiting governor, full-flow filters, 14-gallon fuel tank, dry-air cleaner, positive crankcase ventilation. Pettibone User 1 - manual choke, alternator, alternator regulator, speed-limiting governor, positive crankcase ventilation, full-flow filters, 20-gallon fuel tank, and dry-air cleaner. Pettibone User 2 - manual choke, alternator, alternator regulator, speed limiting governor, full-flow filters, fuel tank capacity sufficient for 8 hours operation, dry-air cleaner. Pettibone User 4 - LPG, Automatic choke, alternator, speed-limiting governor, 43.5-lb fuel tank. United User - LPG model had automatic choke, alternator (41 amp), alternator regulator, speed limiting governor, positive crankcase ventilation system, full-flow filters, and a 22-quart cooling system.

Drive Train/Drive Train Accessories		Clark	Northwestern	Pettibone	United
1.	a. Torque converter?	Yes	Yes	See Note	Yes
NOTE: Pettibone Users 1, 3, and 4 have automatic transmissions/torque converter. Pettibone User 1 has manual 4-speed transmissions/fluid coupling.					
	b. Automatic transmission with at least two forward speeds, reverse, heat exchanger, and capability to shift under full engine torque?	Yes	Yes	See Note 1a Above	Yes
	c. Drive shaft with U-Joints?	Yes	Yes	Yes	Yes
2.	a. Front axle suspension:	Leaf Spring	Leaf Spring	Elliptical Springs	Semi-Elliptic Springs
	b. Rear axle suspension:	Leaf Spring	None	Elliptical Springs	None - Cushion Pads
3.	a. Front wheel size:	6.50 x 10 (See Note)	6.00 x 9	See Note	See Note
NOTE: Clark User specifies Bearcat Grizzly solid-rubber tires. Pettibone User 1 uses 6.00 x 9. Pettibone User 2 uses 6.00 x 9 Bearcat Grizzly solid-rubber tires. Pettibone User 3 uses 6.00 x 9, 10-ply, foam-filled. Pettibone User 4 - 6.00 x 9 Bearcat zero pressure. United User replaced standard 6.00 x 9 with 6.90 x 9.00.					
	b. Ply rating:	6	6	See Note to 3a	6
	c. Number of tires:	2	2	2	2
4.	Rear wheel size:	6.50 x 16 (See Note)	6.50 x 16	See Note	6.50 x 16

NOTE: Clark User - Bearcat Grizzly solid-rubber tires specified. Pettibone User 1 - 7.50 x 16 Goodyear steel guard. Pettibone User 2 - 7.00 x 16. Pettibone User 3 - 7.50 x 16. Pettibone User 4 - 7.00 x 16, Bearcat zero pressure.

	Clark	Northwestern	Pettibone	United
Ply rating:	6	6	See Note	6

NOTE: Pettibone User 1 - unknown. Pettibone User 2 - 6. Pettibone User 3 - 8. Pettibone User 4 - 4. N/A.

Number of tires:	2	See Note	See Note	4
------------------	---	----------	----------	---

NOTE: Northwestern User 1 - 2 tires. Northwestern User 2 - 4 tires. Pettibone User 1 - 4. Pettibone User 2 - 2 tires. Pettibone User 3 - 4 tires. Pettibone User 4 - 2.

Steering/Brakes		Clark	Northwestern	Pettibone	United
1.	Type steering:	Manual	See Note	See Note	Power
NOTE: Northwestern User 1 converted to power. Northwestern User 2 - manual. Pettibone User 1 and User 2 - power. Pettibone User 3 - manual. Pettibone User 4 - power.					
2.	Steering wheel diameter:	18 in.	17 in.	17 in.	18 in.
3.	Turns - lock to lock:	Unknown	5½	Unknown	5¾
4.	Brake type				
	a. Front:	Drum	None	Drum	Drum
	b. Rear:	Drum	Drum	Drum	Drum
5.	Brake				
	a. Actuation:	Hydraulic-split	Hydraulic	Hydraulic	Power-Assisted
	b. Adjustment:	Manual	Manual	Manual	Manual
6.	Parking brake				
	a. Type:	Shoe on Drive Shaft	Shoe on Drive Shaft	Band on Drive Shaft	Shoe on Drive Shaft
	b. Actuation:	Lever	Lever	Lever (Orscheln)	Lever (Orscheln)
7.	Is steering acceptable to operator?	Yes	See Note	Yes	Yes
NOTE: Northwestern User 1 - Poor due to modification of steering system to accept cab. Northwestern User 2 - Yes.					
8.	Is braking system acceptable to operator?	Yes	See Note	Yes	Yes
NOTE: Northwestern User 1 - Poor; should be 4-wheel and power-assisted. Northwestern User 2 - Yes.					

Operator's Compartment		Clark	Northwestern	Pettibone	United
1.	Directional control: a. Actuation: b. Location: c. Type position marking:	Right-hand Floor mount Marked — type unknown	Right-hand Steering column Decals	Right-hand Beside seat Marked — type unknown	Right-hand Console to right of seat Plastic plate attached to console
2.	Seat: a. Type: b. Number: c. Covering:	As furnished 1 Vinyl	As furnished 1 Vinyl	As furnished 1 Vinyl	Bostram T-BAR 2 Vinyl
3.	Dimensional data (in.): a. Vertical clearance between steering wheel and seat: b. Seat height above floor board: c. Floor board height above ground: d. First step height above ground: e. Distance between seat and parking brake: f. Distance between accelerator and brake pedal: g. Brake pedal size:	7 18 24 8 Unknown Unknown Unknown	14 13½ 27 16½ 6½ 3½ 5 x 2¾	7.5 19.5 25 13¾ Unknown Unknown Unknown	9 22 24 14 12.5 2 5 x 2½

Tractor, Dimension, Performance, Misc.	Clark	Northwestern	Pettibone	United
1. Dimensional data (in.):				
a. Length:	102	102½	102	99
b. Width:	55½	55	67	65½
c. Height w/o cab:	62	58½	63	59
d. Wheel base:	55½	65	56½	58
e. Drive tire tread width:	46-15/16	45	57¾	57.7
f. Steer tire tread width:	44	47	40½	47
g. Drive tire clearance to body:	Unknown	4	Unknown	3½ - 4½
h. Ground clearance (min):	6½	6	8¾	6½
i. Exhaust outlet (height):	Unknown	13	Unknown	9
j. Pintle hook height:	11	14	13½	12
2. Vehicle weight (lb):	5650	See Note	6850	5800
NOTE: Northwestern User 1 - 5200. Northwestern User 2 - 6200.				
3. Noise level limits @:				
a. No-load governed engine speed	Unknown	See Note	See Note	See Note
NOTE: Northwestern User 1 considers tractor too noisy. Northwestern User 2 - Unknown. Pettibone Users 1 and 4 specified to be 85dB(A). Pettibone User 2 - Unknown. Pettibone User 3 - Unknown. United User specified to be 90dB(A).				
b. 4000-lb Drawbar Pull	Unknown	See Note 3a	See Note 3a	See Note 3a
4. Color:	Green	Turquoise	See Note	Yellow
NOTE: Pettibone Users 1 and 4 - Safety Alert Orange. Pettibone User 2 - blue/green. Pettibone User 3 - orange.				
5. Non-slip walkway coating?	Yes	Yes	Yes	Yes
6. Tiedowns?	No	No	No	No

Reliability, Availability, and Maintainability		Clark	Northwestern	Pettibone	United
1. General data:					
a. Daily use (hours)	24	16-24	See Note	24	
NOTE: Pettibone Users 1 and 2 - three 8-hour shifts per day. Pettibone User 3 - 8 hours per day. Pettibone User 4 - 16 hours per day.					
b. Are tractors replaced on a planned cycle?	See Note	No	See Note	See Note	
NOTE: Clark User replaces tractors on an 8-year cycle. Pettibone User 1 replaces based on maintenance cost vs. acquisition cost. Pettibone User 2 replaces tractors on a 7- to 8-year schedule. Pettibone User 3 attempts to replace on a planned cycle. Pettibone User 4 - 30,000 hours. United User replaces when maintenance costs reach a certain ratio.					
c. Are dealer repairs performed on a timely basis?	See Note	Yes	See Note	See Note	
NOTE: Clark User does not use dealer service. Pettibone Users 1 and 4 - Yes. Pettibone User 2 does not use dealer service. Pettibone User 3 - parts service unsatisfactory. United User - union contracts prohibit dealer repairing warranty claims/maintenance.					
2. Maintainability:					
a. Does manufacturer furnish a copy of his standard warranty?	Yes	See Note	Yes	See Note	
NOTE: Northwestern User 1 - yes. Northwestern User 2 - no. United User N/A as User's union prohibits dealer-repairing warranty claims; however, dealer may provide parts gratis if User reports failure as warranty related.					
b. Warranty:					
(1) Length:	90 days or 500 hours	90 days	90 days	N/A	
(2) Number of claims:	0	20 to 11 Tractors	Very Few	N/A	
c. Maintenance allocation:					
(1) Operator:	0	0	Checks liquid levels	0	
(2) Mechanic:	100%	100%	100%	100%	

	Clark	Northwestern	Pettibone	United
d. Are special tools required?	No	No	No	No
e. Are all compartments accessible for maintenance?	Yes	Yes	Yes	Yes
f. Repair parts:				
(1) Time to fill emergency orders:	4 to 5 days	12 hours	See Note	48 hours

NOTE: Pettibone Users 1 and 4 - 48 hours. Pettibone User 2 - 5 days. Pettibone User 3 - long time.

(2) Time to fill normal orders:	3 weeks	1 week	See Note	7 days
(3) Any delay because of part unavailability?	No	No	No	No
(4) Stocked by User	See Note	See Note	See Note	See Note

NOTE: Pettibone User 1 - 2 to 3 weeks. Pettibone User 2 - 3 days. Pettibone User 3 - long time. Pettibone User 4 - 2 weeks.

NOTE: Clark User stocks filters and normal automotive tune-up parts. Northwestern User 1 stocks tune-up parts, spare transmission, tires, filters, fan belts. Northwestern User 2 - None; they have only one tractor. Pettibone User 1 stocks filters, batteries, engine, transmission, fan belts, tires, etc. Pettibone User 2 stocks filters, engine overhaul parts, and normal automotive tune-up parts. Pettibone User 3 stocks filters, extra engine, extra transmission, clutches, brake parts. Pettibone User 4 stocks points, plugs, wheel bearings, brake shoes, batteries, spare engine/transmission parts. United User stocks tires, filters, belts, engine, and normal automotive tune-up parts.

3. Scheduled maintenance/interval/times for replacing:				
a. Engine oil filter:	2 weeks/20 min	monthly/15 min	See Note	2 weeks/10 min
b. Engine air filter:	2 weeks/20 min	on condition/5 min	See Note	2 weeks/10 min

NOTE: Pettibone User 1 - monthly/10 to 15 min. Pettibone User 2 - weekly/30 min. Pettibone User 3 2 weeks/15 min. Pettibone User 4 - 200 hr/5 min.

	Clark	Northwestern	Pettibone	United
NOTE: Pettibone User 1 - monthly/10 min. Pettibone User 2 - monthly/15 min. Pettibone User 3 - 2 weeks/15 min. Pettibone User 4 - 200 hr/5 min.				
c. Engine fuel filter:	2 weeks/20 min	yearly/5 min	See Note	2 weeks/15 min
NOTE: Pettibone Users 1, 2, and 4 - Unknown. Pettibone User 3 - 2 weeks/15 min.				
d. Transmission filter:	when needed	yearly	See Note	2 weeks/15 min
NOTE: Pettibone User 1 - Unknown. Pettibone User 2 - check weekly. Pettibone User 3 - 2 weeks/15 min. Pettibone User 4 - 1200 hr/30 min.				
4. Scheduled maintenance interval/time for changing?				
a. Engine Oil	2 weeks/60 min	monthly/15 min	See Note	2 weeks/15 min
NOTE: Pettibone User 1 - monthly/10 to 15 min. Pettibone User 2 - weekly. Pettibone User 3 - bi-weekly. Pettibone User 4 - 200 hr/10 to 15 min.				
b. Transmission:	annually/60 min	annually/30 min	See Note	quarterly/15 min
NOTE: Pettibone User 1 - as required. Pettibone User 2 - 250 hr/30 min. Pettibone User 3 - no schedule. Pettibone User 4 - 1200 hr/30 min.				
c. Cooling System:	annually/2 hours	annually/60 min	See Note	When needed/15 min
NOTE: Pettibone User 1 - flushes every 2 yr, Pettibone User 2 - flushes once a year. Pettibone Users 3 and 4 - no schedule/as required.				
d. Lubrication (chassis):	2 weeks	monthly/30 min	See Note	2 weeks/30 min
NOTE: Pettibone User 1 lubricates monthly/10 to 15 min. Pettibone User 2 - weekly/30 min. Pettibone User 3 - biweekly/10 min. Pettibone User 4 - 200 hr/10 min.				
5. Preventative maintenance times:				

	Clark	Northwestern	Pettibone	United
a. Daily:	0	0	10 to 20 min	0
b. Weekly:	Unknown	0	See Note	1 hr

NOTE: Pettibone User 1 - 0. Pettibone User 2 - 30 min. Pettibone User 3 - 0. Pettibone User 4 - 1 1/4 hr.

c. Monthly:	Unknown	8	See Note	5 hr
-------------	---------	---	----------	------

NOTE: Pettibone User 1 - 0. Pettibone User 2 - 5 hr. Pettibone User 3 - 0. Pettibone User 4 - 7 hr.

6. What is average time to remove and replace the:

a. Starter:	60 min	45 to 60 min	See Note	2 hr
-------------	--------	--------------	----------	------

NOTE: Pettibone User 1 - 15 min. Pettibone User 2 - 60 min. Pettibone User 3 - 60 min. Pettibone User 4 - 20 min.

b. Voltage regulator:	30 min	10 min	See Note	20 min
-----------------------	--------	--------	----------	--------

NOTE: Pettibone User 1 - 15 min. Pettibone User 2 - 30 min. Pettibone User 3 - 30 min. Pettibone User 4 - 10 min.

c. Battery:	15 min	10 to 15 min	10 to 15 min	10 min
d. Fan belt:	60 min	10 to 15 min	See Note	30 min

NOTE: Pettibone User 1 must loosen front motor mount and raise engine to r/r the fan belt - 60 min. Pettibone User 2 - 45 min. Pettibone User 3 - 15 min. Pettibone User 4 - 10 min.

e. Brake shoes:	4 hr	2 hr	4 to 8 hr	2 hr
f. Alternator:	90 min	15 to 30 min	20 to 60 min	30 min

Safety/Human Factors	Clark	Northwestern	Pettibone	United
1. Does the user augment the manufacturer's safety precautions?	Yes	No	See Note	Yes
NOTE: Pettibone Users 1 and 2 augment with own safety precautions. Pettibone User 3 -- no. Pettibone User 4 -- yes.				
2. Does the User know of any safety hazards during:				
a. Operation:	No	See Note	No	No
NOTE: Northwestern Users reported tractors creep in neutral and complained of brakes and suspension.				
b. Maintenance:	No	No	No	No
3. Are the following safety/human factors items adequate?				
a. Controls/gauges:	Yes	Yes	Yes	Yes
b. Control marking:	Yes	Yes	Yes	Yes
c. Operator visibility:	Yes	Yes	Yes	Yes
d. Antiskid surfaces:	Yes	Yes	Yes	See Note
NOTE: United User specifies antiskid surfaces.				
e. Nonhazardous steps:	Yes	See Note	Yes	Yes
NOTE: Northwestern User 1 noted step is not deep enough. Northwestern User 2 -- yes.				
4. Does the operator's size inhibit his performance?	No	No	No	No
5. Does the operator's dress inhibit his performance?	No	See Note	No	No
NOTE: Northwestern User 1 with cab installed on tractor experiences problems. Northwestern User 2 -- no.				
6. Does the sound level result in operator fatigue?	No	See Note	No	No

	Clark	Northwestern	Pettibone	United
NOTE: Northwestern User 1 -- yes. Northwestern User 2 -- no.				
7. What is the noise level of tractor?	Unknown	Unknown	See Note	90 dB(A)
NOTE: Pettibone Users 1 and 4 -- 85 dB(A) Pettibone Users 2 and 3 -- Unknown.				
8. Are noise-level caution (warning) signs posted?	No	No	No	No
9. Is special training required for:				
a. Operators:	No	No	See Note	No
NOTE: Pettibone User 1 trains and licenses all operators. Pettibone Users 2, 3, and 4 -- No.				
b. Maintenance personnel	No	No	See Note	No
NOTE: Pettibone User 1 -- maintenance personnel receive OJT. Pettibone Users 2, 3, and 4 -- No.				

Manuals	Clark	Northwestern	Pettibone	United
1. Are operator, maintenance, repair and parts manuals furnished? Yes	See Note	Yes	Yes	Yes
NOTE: Northwestern User 1 - yes. Northwestern User 2 - no.				
2. Is a lubrication & maintenance guide furnished? Yes	See Note (1)	Yes	No	No
3. Have any difficulties been encountered using these manuals? No	No	No	No	No
4. a. Is the installation/use of options adequately explained? See Note	N/A	Yes	Yes	Yes
NOTE: Clark User uses separate manuals for installing and using optional equipment.				
b. Are separate manuals required for options? Yes	N/A	No	No	No
5. Is there a manual-update system? Yes	No	See Note	Yes	Yes
NOTE: Pettibone Users 1 and 4 - yes. Pettibone Users 2 and 3 - no.				

DISTRIBUTION FOR MERADCOM REPORT 2238

No. Copies	Addressee	No. Copies	Addressee
	Department of Defense	1	Chief, Engineer Division DCSLOG ATTN: AFKC-LG-E HQ Sixth US Army Presidio of San Francisco, CA 94129
12	Defense Documentation Center Cameron Station Alexandria, VA 22314	1	Commander US Army Aberdeen Proving Ground ATTN: STEAP-MT-U (GE Branch) Aberdeen Proving Ground, MD 21005
1	Commander TARCOM DRSTA-GBC Warren, MI 48090	1	Commander US Army Troop Support and Aviation Materiel Readiness Command ATTN: DRSTS-KTE 4300 Goodfellow Blvd St Louis, MO 63120
1	Commander TARCOM DRSTA-WS Warren, MI 48090	1	HQ, USAREUR & Seventh Army DCSENGR, ATTN: AEAEN-MO ATTN: Mil Ops Div APO New York 09403
2	Commander TARCOM DRSTA-MVM Warren, MI 48090	1	Commander USA DARCOM Installation and Services Activity ATTN: DRCIS-RI Rock Island, IL 61201
2	Commander TARCOM DRSTA-QKC Warren, MI 48090	1	President US Army Armor and Engineer Board ATTN: ATZK-AE-TD-E Fort Knox, KY 40121
	Department of the Army	1	Commander OTEA CSTE-POD 5400 Columbia Pike Falls Church, VA 22091
1	Commander US Army Logistics Evaluation Agency DALO-LES New Cumberland Army Depot, New Cumberland, PA 17070	2	GSAFSS Rm 1009 CM 4 (ATTN: Mr. Smith, Mr. McQuire) Washington, DC 20406
1	Commander, HQ TRADOC ATTN: ATEN-ME Fort Monroe, VA 23651	1	Commander, HQ DLA ATTN: DLA-OW Cameron Station, VA Alexandria, VA 22314
1	Commander Packaging, Storage and Containerization Center DRXTO-T Tobyhanna Army Depot Tobyhanna, PA 18966		
2	Commander US Army Materiel Development and Readiness Command Ammunition Center SARAC-DEV Savanna, IL 61704		

No. Copies	Addressee	No. Copies	Addressee
1	Commander US Army Test & Evaluation Com ATTN: DRSTE-AR Aberdeen Proving Ground, MD 21005		MERADCOM
1	Commander US Army Materiel Development & Readiness Command ATTN: DRCDE-DS 5001 Eisenhower Avenue Alexandria, VA 22333	1	Commander, DRDME-Z Technical Director, DRDME-ZT Assoc Tech Dir/R&D, DRDME-ZN Assoc Tech Dir/Engrg & Acq, DRDME-ZE Spec Asst/Matl Asmt, DRDME-ZG Spec Asst/Tech Asmt, DRDME-ZK CIRCULATE
1	Commander US Army Maintenance Management Center ATTN: DRXMD-EV Lexington Bluegrass Army Depot Lexington, KY 40507	1	Chief, Ctrmine Lab, DRDME-N Chief, Engy & Wtr Res Lab, DRDME-G Chief, Elec Pwr Lab, DRDME-E Chief, Cam & Topo Lab, DRDME-R Chief, Mar & Br Lab, DRDME-M Chief, Ctr Intrus Lab, DRDME-X Chief, Matl Tech Lab, DRDME-V Director, Product A&T Directorate, DRDME-T CIRCULATE
1	Commandant US Army Quartermaster School ATTN: ATSM-CD-M Fort Lee, VA 23801	1	Mech & Constr Eqpt Lab, DRDME-H
1	Commander US Army Logistics Center ATTN: ATCL-ET Fort Lee, VA 23801	5 50	Mech Eg Engr Div, DRDME-HM Warehouse & Depot Grp, DRDME-HM
1	Commandant US Army Transportation School ATTN: ATSP-CTD-MC Fort Eustis, VA 23604	1 3 3	Project Officer for Commercial Equipment, DRDME-HC Tech Reports Ofc, DRDME-WP Security Ofc (for liaison officers), DRDME-S
1	AFLC CASO/LODS Federal Center Battle Creek, MI 49016	2 1	Tech Library, DRDME-WC Plans, Programs & Ops Ofc, DRDME-U
1	Commanding Office Navy Ships Parts Control Ctr (Code 3456) Mechanicsburg, PA 17055	1 1	Pub Affairs Ofc, DRDME-I Ofc of Chief Counsel, DRDME-L
1	Commander Defense Construction and Supply Ctr DCSC-SS Columbus, OH 43215		
1	Commandant of the Marine Corps HQ Marine Corp (Code LME-- Mr. Zapf) Washington, DC 20380		